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(54) Ink condensate removal in hardcopy apparatus

(57) Vapour removed from the drying chamber (15) of a hardcopy apparatus is condensed at (20) and passed to a reservoir (25) from which it is intermittently pumped into an ink supply cartridge (30). Cartridge (30) supplies ink (31) from a first bag (32) via a first nozzle (34). As the bag (32) contracts, it allows a second bag (37) to expand to receive the condensate from reservoir (25) via a valving system (75) and a second nozzle (36). In addition, a pump (40) supplies air the second bag (37) via piping (41, 42, 43); by switching over the valving system (75), it is the same pump (40) which is used to transfer the condensate from reservoir (25) to the cartridge (30).

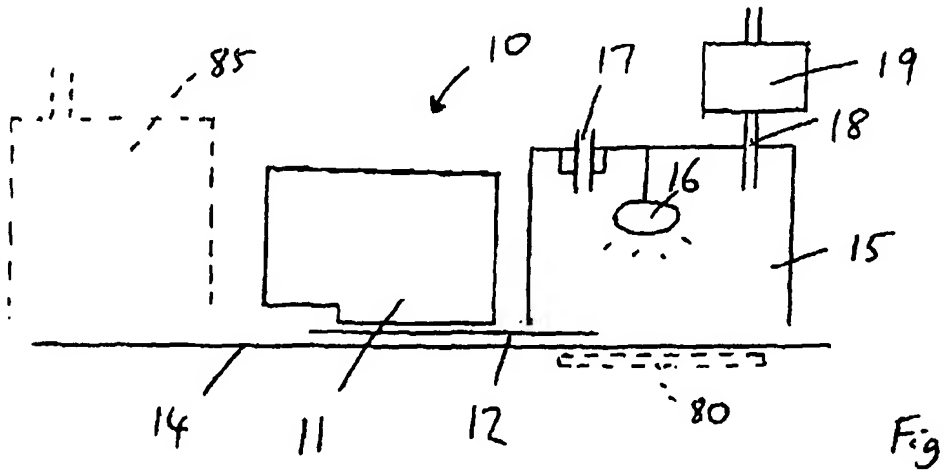

Fig 1

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Descripti n

[0001] The present invention relates to hardcopy apparatus, such as ink-jet printers, which consume ink. In particular it relates to an arrangement for removing the ink waste products, usually predominantly water, from the hardcopy apparatus.

[0002] The ink used in ink-jet printers comprises typically 20% by volume of pigment or dye with traces of various additives, some of which are volatile. The balance, i.e. substantially 80%, is water. When a swath of such ink is deposited on a print media it requires a drying time before the next swath is printed to avoid bleeding problems between the swaths. An end of plot drying time is also required to avoid ink becoming smeared during transfer of the print media to the next stage.

[0003] To allow the ink to dry naturally takes a relative long time, which has an adverse effect on throughput, so ink-jet printers and other hardcopy apparatus which are in heavy use are provided with active drying systems, which eliminate moisture content from the printed surface as quickly as possible. Besides, paper-based media tend to "cockle" when moistened, immediate removal of the water in the media prevents this behaviour. Typically the active drying system comprises a fan and ducting system to blow air over the ink in the print zone, and/or a heater arranged under the printing platen to evaporate the moisture.

[0004] Since the vapour created by the drying system is predominantly water, the atmosphere in a room containing a hardcopy apparatus in heavy use can become unacceptably humid, with condensation forming on windows and walls. A large ink-jet printer can produce approximately 1 litre of water per hour in heavy-duty jobs.

[0005] Accordingly, various methods have been proposed to prevent discharge of the water vapour to the environment. In one method, the vapour emerging from the printzone is condensed and conveyed outside of the hardcopy apparatus, for example to a nearby drain. This has the disadvantage of requiring an external hose connection and requires the apparatus to be located close to a local drain. Moreover, since the condensate will contain chemicals in the form of volatile constituents and unused ink, there may be environmental considerations which do not allow the condensate to be discharged in this way.

[0006] In another method, the condensate is collected in a dedicated container within the hardcopy apparatus. This has the disadvantage of requiring within the apparatus additional space which needs to be readily accessible. In addition, time and effort are required to empty the container. The container also requires maintenance. Problems can also arise if the user or service engineer forgets to empty the container before it is full.

[0007] Certain aspects of the present invention seek to overcome or reduce one or more of the above problems.

[0008] According to a first aspect of the present invention there is provided a method of handling condensate from the printzone of hardcopy apparatus using ink from one or more cartridges characterised in that the condensate is fed to the ink cartridge or one of the cartridges.

[0009] Preferably the condensate is fed to the ink cartridge or one of the cartridges simultaneously with ink being extracted from the cartridge for printing. This provides at least part of the pressure needed to transfer the ink from the cartridge(s) to the printzone. Air may also be fed to the cartridge simultaneously with ink extraction. This is of assistance since the volume of the condensate is always less than the volume of the ink removed.

[0010] According to a second aspect of the present invention, there is provided a hardcopy apparatus employing ink from one or more cartridges and having a printzone where a vapour is produced and means for condensing the vapour to produce a condensate, characterised in that means are provided for feeding the condensate to the ink cartridge or one of the ink cartridges.

[0011] In preferred arrangements means are provided for supplying air to the ink cartridge or one of the ink cartridges. Preferably the air supply means is a pump and a valving arrangement is provided in a first switched configuration of which said pump supplies air to the cartridge and in a second switched configuration of which said pump causes condensate to be fed to the cartridge. This has the advantage that a single pump is used to transfer the air and condensate to the cartridge.

[0012] According to a third aspect of the present invention, there is provided an as an ink cartridge for hardcopy apparatus having a nozzle in communication with a region within the interior of the cartridge for supplying ink characterised in that the cartridge has a second nozzle in communication with another region within the interior of the cartridge, and flexible separating means are provided between said regions..

[0013] An advantage of this arrangement is that use of the space within the cartridge is optimised.

[0014] A preferred embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings, of which:

Figure 1 is a schematic side view of the print zone of an ink-jet printer in accordance with an embodiment of the present invention; and

Figure 2 is a schematic view of an ink supply and drying system for the printer of Figure 1.

[0015] Referring to the drawings, Figure 1 shows the print zone 10 of an ink-jet printer comprising a printhead 11 arranged to fire ink drops to deposit ink on a print media 12 travelling across a print platen 14. As the media 12 moves from printzone 11 from left to right in Figure 1 it enters a drying chamber 15. Here the media 11 is subjected to heat produced by a heating lamp 16 arranged within chamber 15. The relative humidity within

the chamber 15 can exceed 90%. The chamber 15 thus contains an aerosol comprising both small ink droplets, which have been ejected but have not been deposited on the print media, and vapour (predominantly water) caused by evaporation from the drying ink. This aerosol is removed by an air ducting system comprising an air inlet 17 and an air outlet 18 which has an extractor fan 19.

[0016] The extracted vapour is then fed to a condenser 20, Figure 2, which produces a condensate of water contaminated with unused ink and volatile components. The condensate is passed to a reservoir 25.

[0017] Figure 2 shows generally an ink supply system 100 for the print zone 10 of Figure 1. Ink 31 for printhead 11 is supplied in a replaceable cartridge 30 comprising a rigid plastics container 33. To prevent the access of air to the ink 31 it is held within container 33 inside an impermeable and collapsible plastics bag 32 having a mouth in communication with an outlet nozzle or port 34. When printing occurs, a volumetric pump 35 is actuated to transfer ink 31 from bag 32 via nozzle 34 to printhead 11.

[0018] It is known with certain ink-jet cartridges, e.g. Hewlett-Packard types 80, 81 and 83, to inject air into the container 33 to urge ink out of the bag 32. The extraction of ink is controlled by the volumetric pump 35, but the required pumping effort is reduced by the injection of air around the bag 32. In the present embodiment, air is supplied from an air pump 40 via tubing 41, 42, 43 to an inlet nozzle 36 of the cartridge 30. However, in the present embodiment, an intermediate valving arrangement 75 is additionally provided.

In particular, air pump 40 is connected to the input of a two-way switching valve 50. When the valve 50 is switched to a first outlet 51, air is admitted to a first input 61 of a second switching valve 60. The outlet of valve 60 is connected to an inlet nozzle or port 36 of the cartridge 30 which is connected to the mouth of a second impermeable and collapsible plastics bag 37 within container 33.

[0019] The ink-jet cartridge 30 is supplied when new with bag 32 full of ink 31 and occupying most of the volume within container 33. At this stage, bag 37 is in a collapsed state and occupies only a small volume. As pump 35 extracts ink from the bag 32 it becomes smaller and pump 40 is operated to expand bag 37 to occupy the space which is now available. When cartridge 30 is finished, bag 32 is substantially empty of ink and in a collapsed state and bag 37 is substantially expanded state.

[0020] In use, the prior art Hewlett-Packard cartridges were injected solely with air as the ink left its bag. In use of the present embodiment, condensate from the reservoir 25 is injected into the cartridge at certain times. Thus when valve 50 is switched to a second outlet 52 connected to reservoir 25, condensate is pumped via a third switching valve 70 to a second input 62 of valve 60 and from there into bag 37. The level of condensate in reservoir 25 is monitored so that it never becomes full and control means are provided so that valves 50, 60 operate in ganged manner. The printer has four printheads, and switching valve 70 has a plurality of further outlets 75, which serve to share the condensate among the four ink-jet cartridges as they empty.

[0021] In use, cartridge 30 is inserted into the printer. During printing operations, ink is extracted from nozzle 34 and air and condensate are pumped into nozzle 36. After use, the spent cartridge 30 is removed.

[0022] An advantage of the above-described arrangement is that no special operation is needed to remove the condensate. It is automatically removed simultaneously with the normal removal of a spent ink-jet cartridge, which is, of course, readily accessible. Only a small space is required for reservoir 25 and it does not need to be located in an accessible position. The arrangement is environmentally-friendly since no liquid effluent needs to be discharged via hosing and there are minimal vapour emissions from the print zone. A common pump 40 is used to transfer both air and condensate into the bag 37.

[0023] Various modifications may be made to the above-described arrangement. For example the air inlet 17 may be omitted in which case air enters solely at the bottom of the chamber 15.

[0024] Moreover, an additional print media drying and moisture extraction unit 85, positioned before the print zone 11 in the media axis, may be provided with its own separate connection to the condensing circuit. In another modification, the ink in the printzone may be heated instead or in addition by a resistor 80 located underneath the media path. A hot air circulation system may be provided, with the air being heated remote from the printzone.

[0025] Bag 37 may be omitted if container 33 is sufficiently airtight, in which case the air and condensate occupy the interior of the container 33 not occupied by bag 32. Bag 32 may be omitted instead of bag 37. Instead of a bag or bags, the regions within the interior of the cartridge may be separated by a flexible membrane. Initially, the ink is contained between one side of the membrane and part of the walls of the container 33; when the ink has been used up, air and condensate are contained between the other side of the membrane and the remaining part of the walls.

[0026] For hardcopy apparatus with a single printhead, valve 70 may be omitted.

[0027] Instead of pump 40, a separate pump may be used to transfer condensate from the reservoir 25 into the cartridge 30.

[0028] Volumetric pump 35 may be omitted, in which case the injection of air or condensate by pump 40 into bag 37 is used to directly control the flow of ink 31 to printhead 11.

[0029] With a suitable control arrangement, reservoir 25 may be omitted and the outlet tube from condenser 20 may be connected directly to the valving arrange-

ment 75. Furthermore the valving arrangement 75 may be omitted, in which case the output from condenser 20 may pass straight through into bag 37, additional air being pumped in as necessary. The output from condenser 20 may reach the bag solely under the forces of gravity, but a pumped arrangement is preferred, especially when the cartridge still contains a large amount of ink and considerable pressure is required.

[0030] In another modification, an ink cartridge is employed with only one nozzle. In this case, condensate is collected in reservoir 25 until the ink bag in the cartridge is substantially empty of ink. Before removal of the cartridge, the condenser is connected to the nozzle by means of a suitable valving arrangement and the condensate is transferred into the ink bag. A suitable operating arrangement may be provided having a button which is actuated to initiate an ink cartridge replacement procedure. Before allowing access to the ink cartridge, the operation arrangement may effect the condensate transfer process automatically.

[0031] The above described arrangement may be used in other forms of hardcopy apparatus including plotters, scanners, photocopiers and facsimile machines.

Claims

1. A method of handling condensate from the printzone of hardcopy apparatus using ink from one or more cartridges (30) **characterised in that** the condensate is fed to the ink cartridge or one of the cartridges.

2. A method according to claim 1, wherein the condensate is fed to the ink cartridge (30) or one of the cartridges simultaneously with ink being extracted from the cartridge for printing.

3. A method according to claim 2, wherein air is fed to the ink cartridge (30) or one of the cartridges simultaneously with ink being extracted from the cartridge for printing.

4. A method according to any preceding claim, wherein the ink for printing is extracted from a first port (34) of the cartridge (30) and the feed of condensate and/or air to the cartridge is via a second port (36).

5. A hardcopy apparatus employing ink (31) from one or more cartridges (30) and having a printzone (11) where a vapour is produced and means (20) for condensing the vapour to produce a condensate, **characterised in that** means (25, 75) are provided for feeding the condensate to the ink cartridge or one of the ink cartridges.

6. A hardcopy apparatus according to claim 5, wherein the or each cartridge (30) has first and second ports (34, 36), ink (31) passing from the cartridge via the first port (34) to said printzone (11) and said feeding means (25, 75) passes the condensate to the cartridge via the second port (36).

7. A hardcopy apparatus according to claim 5 or 6, wherein the or each cartridge (30) comprises a bag (32) in communication with said first port (34).

8. A hardcopy apparatus according to claim 7, wherein the or each cartridge (30) comprises a bag (33) in communication with said second port (36).

9. A hardcopy apparatus according to any of claims 5 to 8 wherein means (40) are provided for supplying air to the ink cartridge or one of the ink cartridges.

10. A hardcopy apparatus according to claim 9, wherein said air supply means is a pump (40) and a valving arrangement (75) is provided in a first switched configuration of which said pump supplies air to the cartridge (30) and in a second switched configuration of which said pump causes condensate to be fed to the cartridge.

11. An ink cartridge (30) for hardcopy apparatus having a nozzle (34) in communication with a region within the interior of the cartridge for supplying ink **characterised in that** the cartridge has a second nozzle (36) in communication with another region within the interior of the cartridge, and flexible separating means (32, 37) are provided between said regions.

12. A cartridge according to claim 11, wherein said flexible separating means comprises a bag (32) for containing ink (31) and connected to the first nozzle (34).

13. A cartridge according to claim 11 or 12, wherein said flexible separating means comprises a bag (37) connected to the second nozzle (36).

14. A cartridge according to claim 12 or 13 wherein the or each bag (32, 37) is collapsible and can adopt a first state in which it occupies a major part of the cartridge and a second state in which it occupies a minor part of the cartridge.

15. A cartridge according to claim 13 which is supplied in a condition in which the ink containing bag (32) is substantially full of ink and occupies a major part of the cartridge and the second bag (37) is in a collapsed state and occupies a minor part of the cartridge.

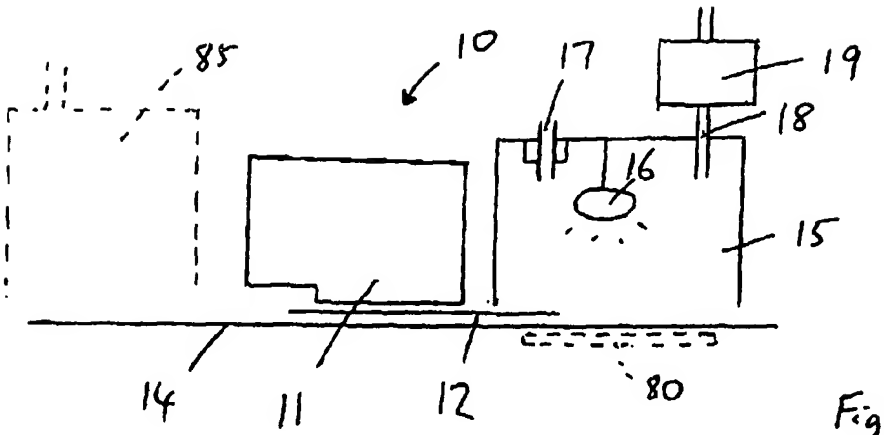
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Fig 1

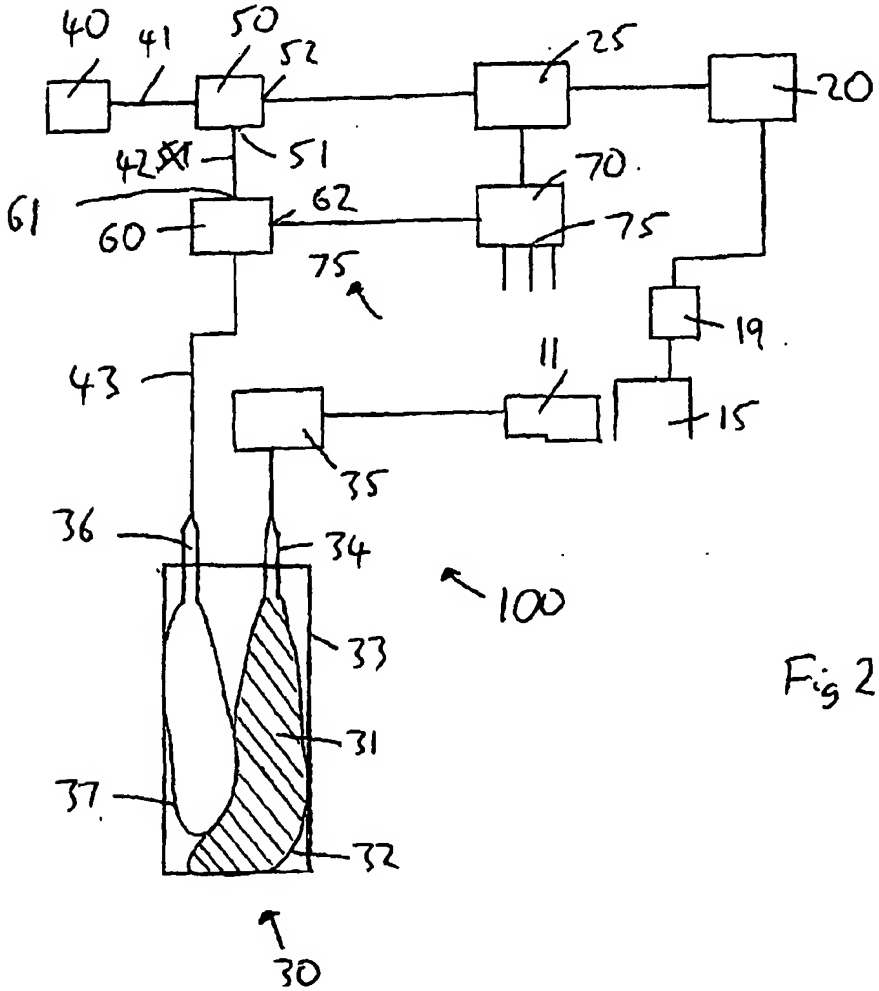
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Fig 2

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EUROPEAN SEARCH REPORT

Application Number
EP 01 12 5980

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	WO 93 17869 A (WILLETT INT LTD) 16 September 1993 (1993-09-16) * page 1, line 24 - page 2, line 9 * * page 3, line 17 - line 27 * * page 5, line 32 - page 6, line 1 * * page 7, line 23 - line 27 * * page 11, line 22 - page 13, line 16 *	1-7,9	B41J11/00 B41J2/18 B41J2/175 B01D5/00
X	PATENT ABSTRACTS OF JAPAN vol. 018, no. 602 (M-1705), 16 November 1994 (1994-11-16) & JP 06 226991 A (SEIKO EPSON CORP), 16 August 1994 (1994-08-16) * abstract *	11-14	
X	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 17, 5 June 2001 (2001-06-05) & JP 08 216428 A (SCHLUMBERGER OVERSEAS SA), 27 August 1996 (1996-08-27) * abstract *	11-15	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
A	US 2001/002952 A1 (SAKAI SHINICHI) 7 June 2001 (2001-06-07) * paragraph '0042! *	1,5	B41J B01D
A	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 04, 30 April 1999 (1999-04-30) & JP 11 014258 A (CANON INC), 22 January 1999 (1999-01-22) * abstract *	1,5	
A	FR 2 709 092 A (MOORE BUSINESS FORMS INC) 24 February 1995 (1995-02-24) * page 4, line 35 - page 5, line 3 *	1,5	
	-/--		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	2 April 2002	Van Oorschot, J

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EUROPEAN SEARCH REPORT

Application Number
EP 01 12 5980

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	EP 0 816 097 A (QUAD TECH) 7 January 1998 (1998-01-07) * column 3, line 58 - column 5, line 1 *	1	
A	FR 2 618 727 A (RICARD CLAUDE) 3 February 1989 (1989-02-03)		
A	PATENT ABSTRACTS OF JAPAN vol. 014, no. 172 (M-0958), 4 April 1990 (1990-04-04) & JP 02 026751 A (MATSUSHITA ELECTRIC IND CO LTD), 29 January 1990 (1990-01-29) * abstract *		
A	GB 2 010 104 A (PATEL N) 27 June 1979 (1979-06-27)		
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)

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02-04-2002

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9317869 A	16-09-1993	AU 3646093 A WO 9317869 A1	05-10-1993 16-09-1993
JP 06226991 A	16-08-1994	NONE	
JP 08216428 A	27-08-1996	NONE	
US 2001002952 A1	07-06-2001	JP 2001166596 A	22-06-2001
JP 11014258 A	22-01-1999	NONE	
FR 2709092 A	24-02-1995	FR 2709092 A1	24-02-1995
EP 0816097 A	07-01-1998	EP 0816097 A2 JP 10086410 A	07-01-1998 07-04-1998
FR 2618727 A	03-02-1989	FR 2618727 A1	03-02-1989
JP 02026751 A	29-01-1990	NONE	
GB 2010104 A	27-06-1979	NONE	

EPO FORM P0459

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